Devising production methods for graphene

Ohio State University researchers recently discovered potential keys to mass producing a specific pattern of graphite in a layer just one atom thick, signaling a breakthrough that could lead to "graphene" challenging silicon as the preferred material for manufacturing faster, more efficient computer chips.

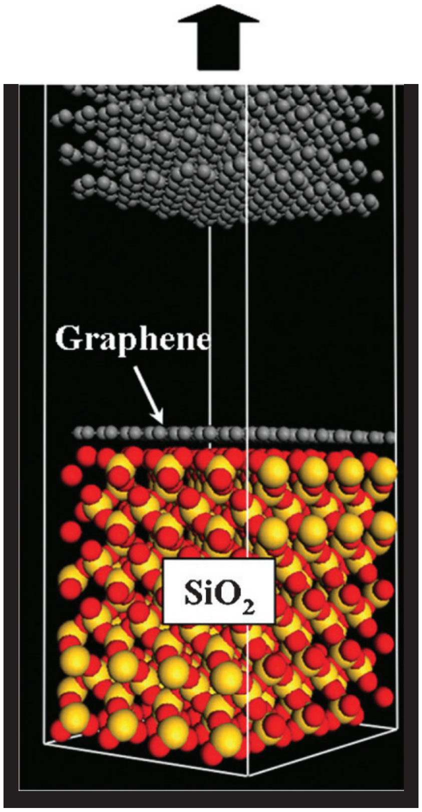
While scientists have known of graphene's potential for many years, electronics industry officials became particularly excited when researchers found that thin layers of graphite are highly stable, visible under the right conditions even when only one atom thick, stronger than steel and conducts electricity quickly and in exceptional ways.

Wolfgang Windl, Ph.D., associate professor of Materials Science and Engineering, and co-workers set out to develop a method for producing very accurate, very position-specific graphene patterns in a way that industry could use to manufacture computer chips. To test their technique, Windl turned to the resources of the Ohio Supercomputer Center and the Vienna Ab-initio Simulation Package.

"The calculations are computationally very demanding for the systems under consideration due to their size and complexity," Windl explained. "Based on our initial success with these computer simulations, we currently model adhesion on different substrates along with the resulting electrical transport through the graphene to optimize the stamping process and the resulting devices."

With confirmation from their computer models, Windl's team from OSU's Center for Emergent Materials successfully sheared off graphite layers that were about ten atom-layers thick and have initiated the process of obtaining a patent on the technique. ■

Project lead: Wolfgang E. Windl, The Ohio State University
Research title: Toward site-specific stamping of graphene
Funding sources: National Science Foundation, The Ohio State University



Investigating new opportunities for doping

Modern flashlights with bright, white LEDs probably use a mixed indium-gallium nitride alloy as semiconductor to convert electricity into light. A Blu-ray disk system also employs a blue InGaN-based laser. However, indium is becoming scarce and costly, sending researchers scurrying to find an alternative technology. Walter Lambrecht and colleagues at Case Western Reserve University are investigating the properties of a similar, if less familiar, material – zinc germanium nitride.

"We are collaborating with Dr. Kathleen Kash's group, which is growing this and related materials by characterizing and predicting their fundamental properties," said Lambrecht, Ph.D., a professor of physics at Case Western Reserve University. He explains: "To convince people that this material is viable for opto-electronic technology, an understanding of its native defects and doping properties is essential. We think that the three-element nature of this new semiconductor provides new opportunities for doping, because one can substitute each one of these elements separately."

Lambrecht performs quantum mechanical calculations of the electronic properties of semiconductor point defects on the IBM Glenn Cluster at the Ohio Supercomputer Center. The software used for these calculations is under continuous development by an informal group of collaborators to which Lambrecht belongs and which is headed by Mark van Schilfgaarde at Arizona State University. One of the main efforts of the group is to use new approaches to remove the limitations of so-called local density approximations, allowing for a more sophisticated treatment of electronic correlations that is essential to understand defect properties. ■

Project lead: Walter Lambrecht, Case Western Reserve University
Research title: Point defects and doping in wide band gap semiconductors
Funding source: National Science Foundation, Army Research Office

above: Walter Lambrecht is investigating zinc germanium nitride as an alternative to the mixed indium-gallium nitride alloy that provides LED flashlights with their brilliant luminosity.